

Synthesis of 5-(4-Y-benzyl)-1,3-thiazolidine-2-thiones and 5-(4-Y-benzyl)-1,3-selenoazolidine-2-thiones

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Sodium hydrogen sulfide and selenide react with 2-chloro-3-(4-Y-phenyl)-propyl isothiocyanates and phenylallyl isothiocyanate to yield sodium salts of dithiocarbamate and selenothiocarbamate which, upon acidification with dilute hydrochloric acid, undergo an intramolecular cyclization under formation of 5-(4-Y-benzyl)-1,3-thiazolidine-2-thiones and their selenium analogues. The structure of products was deduced from ^1H -n.m.r., i.r., and Raman spectra.

При воздействии гидросульфида и гидроселенида натрия на 2-хлор-3-(4-Y-фенил)пропил изотиоцианаты и фенилаллилизотиоцианат образуются натриевые соли дитиокарбамата и селенотиокарбамата, которые при окислении разбавленной хлористоводородной кислотой интрамолекулярно замыкают кольцо и образуют 5-(4-Y-бензил)-1,3-тиазолидин-2-тионы и их селеновые аналоги. Строение финальных продуктов было определено на основании спектров ^1H -ЯМР, ИК и рамановских спектров.

In our previous papers [1, 2] we described the preparation of new heterocyclic compounds from isothiocyanates and alkali metal hydrogen sulfides. The resulting salt of dithiocarbamate, the stability of which depends on the carbon containing moiety [3], is either embodied in the heterocycle by a condensation reaction with another substance, or stabilized by an intramolecular cyclization provided there is a capable reaction centre in its molecule. These facts were evaluated for the synthesis of new heterocyclic compounds possessing an $\text{>N}-\underset{\text{C}}{\text{S}}$ grouping [4, 5].

In contrast to other methods of preparation [6—9], 2-chloro-3-(4-Y-phenyl)-propyl isothiocyanates [10] were the starting chemicals for preparation of 5-(4-Y-benzyl)-1,3-thiazolidine-2-thiones (Table 1) and -1,3-selenoazolidine-2-thiones (Table 2) (Scheme 1). The above-mentioned isothiocyanates were treated with a methanolic solution of sodium hydrogen sulfide and in the case of sodium hydrogen selenide also under nitrogen. As found, a precipitation takes place during the reaction. The reaction medium was adjusted with dilute hydrochloric acid (1:1) to pH 6—7, the crude product filtered off and crystallized from a suitable solvent.

Table 1

Characteristic data of 5-(4-Y-benzyl)-1,3-thiazolidine-2-thiones

| Compound | Y | Formula | M | Calculated/found | | | | Yield % | M.p. °C | IR $\bar{\nu}$, cm ⁻¹ | | | ¹ H-n.m.r. | | δ , p.p.m. | | | |
|----------|-------------------|--|-------|------------------|------|-------|-------|---------|---------|-----------------------------------|--------------------|------|-----------------------|--------------------|--------------------|-------------------|-------------------------------|-------------------|
| | | | | % C | % H | % N | % S | | | NH _{as} | NH _{free} | NCS | Y | CH _{2(A)} | CH _{2(C)} | CH _(B) | C ₆ H ₄ | NH _(D) |
| I | H | C ₁₀ H ₁₁ S ₂ N | 209.3 | | | | | 92.3 | 92—94* | 3180 | 3400 | 1466 | — | 2.97 d | 3.36 m | 4.45 m | 7.22 s | 8.00 s |
| II | CH ₃ | C ₁₁ H ₁₃ S ₂ N | 223.3 | 58.8 | 6.3 | 6.2 | 28.6 | 89.1 | 120—122 | 3140 | 3400 | 1465 | 2.29 s | 2.92 d | 3.4 m | 4.4 m | 7.05 s | 8.23 s |
| | | | | 58.64 | 6.21 | 6.09 | 28.43 | | | | | | | | | | | |
| III | CH ₃ O | C ₁₁ H ₁₃ S ₂ NO | 239.3 | 54.9 | 5.9 | 5.8 | 26.7 | 87.3 | 124—126 | 3160 | 3400 | 1468 | 3.77 s | 2.92 d | 3.35 m | 4.38 m | 7.02 s | 7.73 s |
| | | | | 54.76 | 5.80 | 5.63 | 26.59 | | | | | | | | | | | |
| IV | Br | C ₁₀ H ₁₀ S ₂ NBr | 288.2 | 41.7 | 3.5 | 4.8 | 22.2 | 94.7 | 130—132 | 3145 | 3400 | 1467 | — | 2.92 d | 3.42 m | 4.38 m | 7.07 s | 7.65 s |
| | | | | 41.53 | 3.38 | 4.65 | 22.15 | | | | | | | | | | | |
| V | NO ₂ | C ₁₀ H ₁₀ S ₂ N ₂ O ₂ | 254.3 | 47.2 | 3.9 | 11.0 | 25.2 | 86.7 | 128—130 | 3152 | 3400 | 1462 | — | 3.17 d | 3.62 m | 4.48 m | 7.22 s | 7.86 s |
| | | | | 47.09 | 3.81 | 10.85 | 25.07 | | | | | | | | | | | |

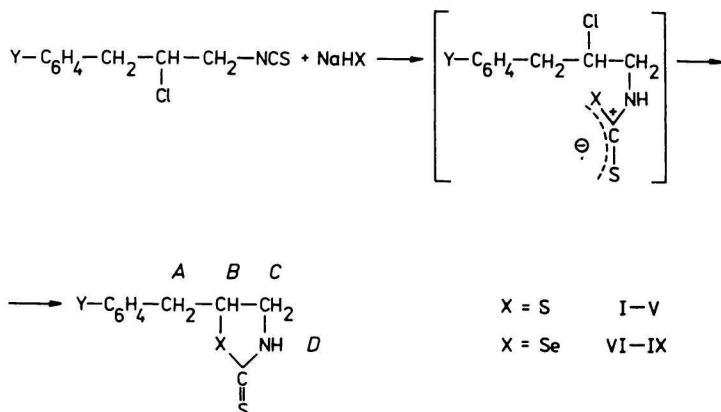
s — singlet, d — doublet, m — multiplet.

* Ref. [7] m.p. 95.5—96.

Table 2

Characteristic data of 5-(4-Y-benzyl)-1,3-selenoazolidine-2-thiones

| Compound | Y | Formula | M | Calculated/found | | | | Yield % | M.p. °C | IR | \bar{v} , cm ⁻¹ | ¹ H-n.m.r. | | | | δ , p.p.m. | |
|----------|-------------------|--|--------|------------------|--------------|--------------|----------------|---------|---------|----------------------|------------------------------|-----------------------|--------------------|--------|--------|--------------------|--------------------|
| | | | | % C | % H | % N | % S | | | | | NH _{as} | NH _{free} | NCS | Y | CH _{2(A)} | CH _{2(C)} |
| VI | H | C ₁₀ H ₁₁ NSSe | 256.2 | 46.87 46.73 | 4.32 4.15 | 5.46 5.31 | 12.47 12.29 | 77.6 | 105—107 | 3160 3390 1470 | — | 2.95 d | 3.42 m | 4.50 m | 7.28 s | 7.85 s | |
| VII | CH ₃ | C ₁₁ H ₁₃ NSSe | 270.2 | 48.88 48.72 | 4.85 4.70 | 5.18 5.09 | 11.88 11.69 | 76.3 | 113—115 | 3140 3390 1470 | 2.31 s | 2.96 d | 3.42 m | 4.36 m | 7.01 s | 7.92 s | |
| VIII | CH ₃ O | C ₁₁ H ₁₃ NSSeO | 286.2 | 46.15 46.07 | 4.57 4.51 | 4.89 4.77 | 11.20 11.13 | 75.3 | 118—119 | 3150 3390 1470 | 3.77 s | 2.95 d | 3.42 m | 4.35 m | 7.05 s | 7.87 s | |
| IX | Br | C ₁₀ H ₁₀ NSSeBr | 335.13 | 35.84 35.71 | 3.00 2.96 | 4.17 4.11 | 9.56 9.43 | 75.9 | 135—137 | 3140 3390 1470 | — | 2.95 d | 3.43 m | 4.35 m | 7.07 s | 7.85 s | |



Scheme 1

The reactivity of the halogen is very high in accordance with previous findings [11] concerning the reactivity of alkylhalogen isothiocyanates, which react with amines, hydroxy compounds, thiols and carbanions to form derivatives of thiazoline.

Sodium hydrogen sulfide and selenide react with phenylallyl isothiocyanate under the same reaction conditions as in the former case to yield compounds which are, according to m.p., i.r. and ^1H -n.m.r. spectra, identical with *I* and *VI*. This procedure offers a new access to the above-mentioned 5-(4-Y-benzyl)-1,3-thiazolidine-2-thiones and their selenium analogues which were not, with the exception of *I*, reported in the literature as yet.

The intermediate selenothiocarbamates formed upon reaction of isothiocyanates with sodium hydrogen selenide could also cyclize under formation of thiazolidine-2-selenones; nevertheless selenoazolidine-2-thiones were found to be the products due to a higher nucleophilicity of selene. This fact is corroborated by the i.r. spectra of both types of substances: the intense absorption band associated with the stretching vibrations of the >N-C=S grouping [12] appears at $1462-1468\text{ cm}^{-1}$, whereas the other two in the $1420-1260$ and $1140-960\text{ cm}^{-1}$ ranges. Comparison of Raman spectra of compounds under investigation shows an accordance at about 1050 cm^{-1} (absorption of the C=S group) and differences in the $450-650$ and $2850-3000\text{ cm}^{-1}$ regions characteristic of the stretching vibrations of the C-X-C bond (X=S, Se) and $-\text{CH}-$ stretching vibrations, respectively; this indicates that both types of compounds have the thione group embodied in the molecule. The unambiguous proof that selenium is a constituent of the heterocycle has already been brought forward by mass spectrometry [5].

The structure of the synthesized compounds was also evidenced by ^1H -n.m.r. spectra showing, in addition to signals due to substituents and aromatic protons,

a doublet of the methylene group $\text{CH}_{2(A)}$ (p.p.m., δ scale, 2.92—3.17), a multiplet of the skeletal methylene group $\text{CH}_{2(C)}$ (3.35—3.62), a multiplet of the methine group $\text{CH}_{(B)}$ (4.35—4.50), and a singlet of the group $\text{NH}_{(D)}$ (7.65—8.32). The assignment of these signals to the respective protons was backed by results of our study [10] dealing with 2-chloro-3-(4-Y-phenyl)propyl isothiocyanates.

Experimental

The Raman spectra of solid substances in capillary tubes were measured with a Spex Ramanolog 4 apparatus (excitation with green line of $\lambda = 514$ nm generated in an argon ion laser Spectra Physic 164), the wavelength scale being contrasted with the spectrum of CCl_4 .

The i.r. spectra of chloroform solutions were recorded with a UR-20 spectrophotometer (Zeiss, Jena) calibrated against a polystyrene foil.

The ^1H -n.m.r. spectra were taken with a Tesla BS 487 apparatus operating at 80 MHz.

5-(4-Y-Benzyl)-1,3-thiazolidine-2-thiones

Hydrogen sulfide (0.34 g; 10 mmol) was introduced into a solution of sodium hydroxide (0.4 g; 10 mmol) in methanol (10 ml) till the change in colour took place. An addition of the respective isothiocyanate (2.5 mmol) resulted in a turbidity which, after acidification with dilute hydrochloric acid (1 : 1), altered either to the oily products *I*, *II*, *V* or to precipitates *III*, *IV*; these were separated, dissolved in chloroform, boiled with charcoal, filtered and crystallized from chloroform—ether.

5-(4-Y-Benzyl)-1,3-selenoazolidine-2-thiones

Anhydrous ethanol (8 ml) was added under constant stirring and cooling to a mixture of powdered selenium (0.32 g; 4 mmol) and sodium borohydride (0.15 g; 3.9 mmol) in a nitrogen atmosphere [13]. After some minutes the stepwise addition of the respective isothiocyanate (1.5 mmol) to the sodium hydrogen selenide solution just formed resulted in precipitation of the product. The reaction medium was adjusted by dilute hydrochloric acid (1 : 1) to a slight acid reaction, and the solvent distilled off. The final product was dissolved in chloroform, the unreacted selenium removed by filtration and the product crystallized from chloroform—tetrachloromethane. Characteristic data of the synthesized products are listed in Tables 1 and 2.

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